

WHAT IS CLAIMED IS:

1. A device for extending a character region in an image, comprising:
 - an input part for receiving an input image;
 - 5 a block classification part for classifying the input image into character blocks and background blocks, and converting pixels in the character blocks into pixels having a first brightness value and pixels in the background blocks into pixels having a second brightness value;
 - a position search part for searching for left, right, top and bottom positions of a
 - 10 character region by horizontally and vertically scanning the block-classified image, and determining a position of the character region;
 - an region of contents (ROC) extraction part for extracting an image in the determined position of the character region from the input image; and
 - an ROC extension part for extending the extracted image of the character
 - 15 region to a size of the input image.
2. The device of claim 1, wherein the block classification part comprises:
 - an image division part for dividing the input image into blocks having a predetermined size;
 - 20 a discrete cosine transform (DCT) conversion part for DCT-converting the divided blocks output from the image division part;
 - an energy calculation part for calculating a sum of absolute values of dominant DCT coefficients in each of the DCT-converted blocks, and outputting the calculated sum as an energy value of a corresponding block;
 - 25 a threshold calculation part for summing up the energy values calculated for the respective blocks, output from the energy calculation part, and generating a threshold by dividing the summed energy value by the total number of the blocks;
 - a classification part for sequentially receiving the block energy values output from the energy calculation part, and classifying the blocks into character blocks or
 - 30 background blocks by comparing the received block energy values with the threshold; and
 - a block filling part for filling the character blocks with pixels having a first

brightness value and filling the background blocks with pixels having a second brightness value.

3. The device of claim 2, wherein each of the blocks has a size of 8×8
5 pixels, and an energy value of each block is calculated by

$$S^k = \sum_{i=1}^9 |D_i^k|$$

where $|D_i^k|$ denotes an i^{th} dominant DCT coefficient of a k^{th} block, and S^k denotes the sum of the absolute values of the dominant DCT coefficients in the k^{th} block.

- 10 4. The device of claim 1, wherein the position search part searches a position of a character region by horizontally and vertically scanning the block-classified image, and determines a position of the character region according to the search result so that the character region has an aspect ratio of the input image.

- 15 5. The device of claim 1, wherein the ROC extension part performs bilinear interpolation on the extracted image of the character region in accordance with the following equation:

$$\begin{aligned} v(x, y) &= (1 - \Delta x)(1 - \Delta y)u(m, n) + (1 - \Delta x) \Delta y u(m, n + 1) \\ &\quad + \Delta x(1 - \Delta y)u(m + 1, n) + \Delta x \Delta y u(m + 1, n + 1) \\ \text{where } \Delta x &= x - m \\ \Delta y &= y - n \end{aligned}$$

- 20 6. A device for extending a character region in an image, comprising:
an input part for receiving an input image;
a block classification part for classifying the input image into character blocks and background blocks, and converting pixels in the character blocks into pixels having a first brightness value and pixels in the background blocks into pixels having a second
25 brightness value;

a median filter for performing median filtering on an image output from the block classification part to remove blocks erroneously classified as character blocks;

a position search part for searching for left, right, top and bottom positions of a

character region by horizontally and vertically scanning the median-filtered image, and determining a position of the character region;

an ROC (Region Of Contents) extraction part for extracting an image in the determined position of the character region from the input image; and

5 an ROC extension part for extending the extracted image of the character region to a size of the input image.

7. The device of claim 6, wherein the median filter determines isolated character blocks as erroneously classified character blocks.

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8. A device for extending a character region in an image, comprising:

an input part for receiving an input image;

a mean filter for performing mean filtering on the input image to blur the input image;

15 a block classification part for classifying the mean-filtered image into character blocks and background blocks, and converting pixels in the background blocks into pixels having a first brightness value and pixels in the background blocks into pixels having a second brightness value;

a median filter for performing median filtering on an image output from the
20 block classification part to remove blocks erroneously classified as character blocks;

a position search part for searching for left, right, top and bottom positions of a character region by horizontally and vertically scanning the median-filtered image, and determining a position of the character region;

an region of contents (ROC) extraction part for extracting an image in the
25 determined position of the character region from the input image; and

an ROC extension part for extending the extracted image of the character region to a size of the input image.

9. A device for extending a character region in an image, comprising:

30 an input part for receiving an input image;

a mean filter for performing mean filtering on the input image to blur the input image;

a block classification part for classifying the mean-filtered image into character blocks and background blocks, and converting pixels in the character blocks into pixels having a first brightness value and pixels in the background blocks into pixels having a second brightness value;

5 a subsampling part for subsampling pixels in the image output from the block classification part to reduce the number of the pixels;

 a median filter for performing median filtering on the subsampled image to remove blocks erroneously classified as character blocks;

 an interpolation part for performing interpolating on the median-filtered image
10 to extend the median-filtered image to a size of the input image;

 a position search part for searching for left, right, top and bottom positions of a character region by horizontally and vertically scanning the block-classified image, and determining a position of the character region;

 an region of contents (ROC) extraction part for extracting an image in the
15 determined position of the character region from the input image; and

 an ROC extension part for extending the extracted image of the character region to a size of the input image.

10. The device of claim 9, wherein the subsampling part subsamples the
20 pixels at a subsampling ratio of $(2:1)^2$.

11. A method for extending a character region in an image, comprising the steps of:

 receiving an input image;

25 classifying the input image into character blocks and background blocks, and converting pixels in the character blocks into pixels having a first brightness value and pixels in the background blocks into pixels having a second brightness value;

 searching for left, right, top and bottom positions of a character region by horizontally and vertically scanning the block-classified image, and determining a
30 position of the character region;

 extracting an image in the determined position of the character region from the input image; and

extending the extracted image of the character region to a size of the input image.

12. The method of claim 11, wherein the block classification step
5 comprises the steps of:

dividing the input image into blocks having a predetermined size;

discrete cosine transform (DCT) -converting the divided blocks;

calculating a sum of absolute values of dominant DCT coefficients in each of
the DCT-converted blocks, and outputting the calculated sum as an energy value of a
10 corresponding block;

summing up the energy values calculated for the respective blocks, and
generating a threshold by dividing the summed energy value by the total number of the
blocks;

sequentially receiving the block energy values, and classifying the blocks into
15 character blocks or background blocks by comparing the received block energy values
with the threshold; and

filling the character blocks with pixels having a first brightness value and
filling the background blocks with pixels having a second brightness value.

20 13. The method of claim 12, wherein each of the blocks has a size of 8×8
pixels, and an energy value of each block is calculated by

$$S^k = \sum_{i=1}^9 |D_i^k|$$

where $|D_i^k|$ denotes an i^{th} dominant DCT coefficient of a k^{th} block, and S^k denotes the
sum of the absolute values of the dominant DCT coefficients in the k^{th} block.

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14. The method of claim 11, wherein the position search step comprises
the steps of:

searching for a position of a character region by horizontally and vertically
scanning the block-classified image;

30 determining a position of the character region according to the search result;
and

correcting the determined position of the character region so that the character region has an aspect ratio of the input image.

15. The method of claim 11, wherein the extracted image of the character
5 region is subject to bilinear interpolation in accordance with the following equation.

$$v(x, y) = (1 - \Delta x)(1 - \Delta y)u(m, n) + (1 - \Delta x) \Delta y u(m, n + 1) \\ + \Delta x(1 - \Delta y)u(m + 1, n) + \Delta x \Delta y u(m + 1, n + 1)$$

$$\text{where } \Delta x = x - m$$

$$\Delta y = y - n$$

16. A method for extending a character region in an image, comprising the steps of:
- 10 receiving an input image;
- classifying the input image into character blocks and background blocks, and converting pixels in the character blocks into pixels having a first brightness value and pixels in the background blocks into pixels having a second brightness value;
- performing median filtering on the block-classified image to remove blocks
15 erroneously classified as character blocks;
- searching for left, right, top and bottom positions of a character region by horizontally and vertically scanning the median-filtered image, and determining a position of the character region;
- extracting an image in the determined position of the character region from the
20 input image; and
- extending the extracted image of the character region to a size of the input image.

17. The method of claim 16, wherein the median filtering step comprises
25 the step of determining isolated character blocks as erroneously classified character blocks.

18. A method for extending a character region in an image, comprising the steps of:

receiving an input image;
performing mean filtering on the input image to blur the input image;
classifying the mean-filtered image into character blocks and background
blocks, and converting pixels in the background blocks into pixels having a first
5 brightness value and pixels in the background blocks into pixels having a second
brightness value;
performing median filtering on the block-classified image to remove blocks
erroneously classified as character blocks;
searching for left, right, top and bottom positions of a character region by
10 horizontally and vertically scanning the median-filtered image, and determining a
position of the character region;
extracting an image in the determined position of the character region from the
input image; and
extending the extracted image of the character region to a size of the input
15 image.

19. A method for extending a character region in an image, comprising the
steps of:

receiving an input image;
20 performing mean filtering on the input image to blur the input image;
classifying the mean-filtered image into character blocks and background
blocks, and converting pixels in the character blocks into pixels having a first brightness
value and pixels in the background blocks into pixels having a second brightness value;
subsampling pixels in the block-classified image to reduce the number of the
25 pixels;
performing median filtering on the subsampled image to remove blocks
erroneously classified as character blocks;
performing interpolation on the median-filtered image to extend the median-
filtered image to a size of the input image;
30 searching for left, right, top and bottom positions of a character region by
horizontally and vertically scanning the block-classified image, and determining a
position of the character region;

extracting an image in the determined position of the character region from the input image; and

extending the extracted image of the character region to a size of the input image.

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20. The method of claim 19, wherein the pixels are subsampled at a subsampling ratio of $(2:1)^2$.